Research: Educational and Psychological Issues

Self-reported diabetes self-management competence and support from healthcare providers in achieving autonomy are negatively associated with diabetes distress in adults with Type 1 diabetes

J. Mohn[1,2,5], M. Graue[5,6], J. Assmus[3], V. Zoffmann[4], H. B. Thordarson[1], M. Peyrot[7] and B. Rokne[2,8]

[1]Department of Medicine, Section of Endocrinology, Haukeland University Hospital, [2]Department of Global Public Health and Primary Care, University of Bergen, [3]Haukeland University Hospital, Centre for Clinical Research, Bergen, Norway, [4]Research Unit Women's and Children's Health, Copenhagen University Hospital, Rigshospitalet and the Institute of Clinical Medicine, Copenhagen University, Copenhagen, Denmark, [5]Bergen University College, Centre for Evidence-Based Practice, [6]Department of Pediatrics, Haukeland University Hospital, Bergen, Norway, [7]Department of Sociology, Loyola University Maryland, Baltimore, MD, USA and [8]Department for Research and Development, Haukeland University Hospital, Bergen, Norway

Abstract

Aim   To investigate the associations of self-perceived competence in diabetes management and autonomy support from healthcare providers with diabetes distress in adults with Type 1 diabetes mellitus that is not optimally controlled [$HbA_{1c} \geq 64$ mmol/mol (8.0%)].

Methods   This cross-sectional study comprised blood sampling and three self-report questionnaires, the Problem Areas in Diabetes scale, the Perceived Competence in Diabetes Scale and a measure of autonomy support by healthcare providers, the Health Care Climate Questionnaire. We fitted blockwise linear regression models to assess the associations between Problem Areas in Diabetes score and the variables of interest (autonomy support and perceived diabetes competence), controlling for clinical and sociodemographic variables.

Results   Of the study sample [$n = 178$; mean age 36.7 ($\pm$10.7) years], 31.5% had long-term complications and 43.2% reported elevated ($\geq$40) Problem Areas in Diabetes scores. A significant negative association was found between autonomy support and Problem Areas in Diabetes score (B = -3.61, $P = 0.001$), indicating that lower autonomy support was associated with greater diabetes distress. When perceived competence was controlled, it mediated the association of autonomy support with diabetes distress, reducing it to non-significance. There was a significant negative association between perceived competence and Problem Areas in Diabetes score (B = -8.89, $P < 0.001$), indicating that lower perceived competence was associated with greater perceived distress.

Conclusions   There was an indirect (fully mediated) relationship between autonomy support and diabetes distress; autonomy support was associated with increased perceived competence, which, in turn, was associated with reduced distress. Healthcare providers' communication styles enhancing perceived competence through autonomy support may contribute to effective treatment for people with Type 1 diabetes and suboptimum glycaemic control.

Diabet. Med. 32, 1513–1519 (2015)

Introduction

Severe emotional distress in people with diabetes substantially increases the burden of the condition [1]. Diabetes distress has been found to negatively influence glycaemic control [2] and quality of life [3]. Psychosocial problems have been documented worldwide for both Type 1 and Type 2 diabetes mellitus [4]. Fisher *et al.* [5] emphasize that diabetes distress has stronger associations with psychological, behavioural and social outcomes than depression. The personal burden of living with diabetes is partly related to the level of self-care, in that the individual's efforts to self-monitor blood glucose, manage insulin, eat healthily and

What's new?

- This study highlights the relationship between self-perceived autonomy support and the level of diabetes distress among adults with Type 1 diabetes.

- Significant negative associations were found between the perceived level of autonomy support and diabetes distress, mediated through self-perceived diabetes competence level.

- These observations suggest that healthcare providers should regard methods supportive of patient autonomy as essential factors in understanding and handling diabetes distress and, in turn, improving self-management of the condition.

exercise regularly is required to attain optimum treatment outcomes [6]. To manage these demands, the individual's multifaceted competence level is of great importance [7].

As people become more autonomously motivated, they feel more competent and better able to attain relevant outcomes [8,9]. According to Self-Determination Theory, people experience a sense of competence when they know that they are able to control important health outcomes such as their glucose levels. Autonomy refers to the perception that one is the source of one's own behaviour and concerns the experience of initiating behaviours [10]. When healthcare providers support patient autonomy, health-relevant behaviours and competence are enhanced [11].

In light of Self-Determination Theory, and to broaden our understanding of factors that might have an impact on diabetes distress, we sought to identify how self-perceived autonomy support and self-perceived competence among people with diabetes are associated with diabetes distress in adults with Type 1 diabetes and suboptimum metabolic control. We investigated the hypothesis that self-perceived autonomy support is associated with higher self-perceived competence in diabetes management and, in turn, with lower diabetes distress in adults with Type 1 diabetes and HbA_{1c} levels that are above target.

Patients and methods

The present study was conducted at a diabetes outpatient clinic at a university hospital in Western Norway. The hospital's population is ethnically stable and homogeneous, and includes both rural and urban populations. The data presented are baseline data from a randomized, controlled, group-based intervention study conducted among people with Type 1 diabetes who had suboptimum glucose control over an extended period. The analyses reported in the present paper used a cross-sectional design.

From March 2011 to March 2013, all 561 people with Type 1 diabetes attending consultations at the University
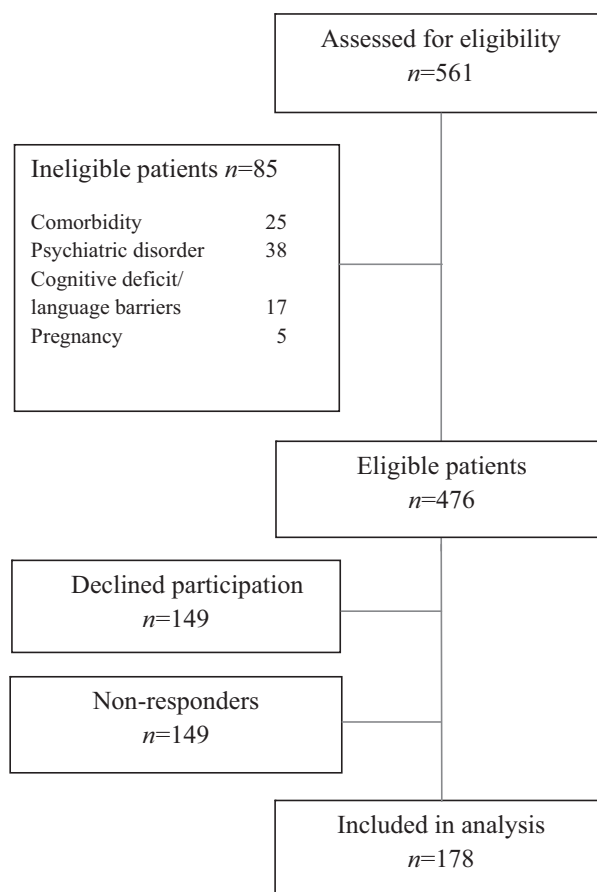
FIGURE 1 Study sample.

Hospital were assessed for eligibility according to the study's inclusion/exclusion criteria (Fig. 1). The following inclusion criteria were used: age 18–55 years; Type 1 diabetes diagnosis for at least 1 year; HbA_{1c} ≥64 mmol/mol (≥8.0%) on one or two occasions during the year preceding the study; and at least two daily insulin injections or continuous subcutaneous insulin infusion. Exclusion criteria were: severe medical comorbidity (e.g. end-stage renal disease, severe heart failure, severe cancer) and/or a medical history that included a major psychiatric diagnosis (e.g. schizophrenia, severe depression, bipolar disorder). Additional exclusion criteria were: inadequate reading/speaking skills in Norwegian; cognitive deficiency (e.g. Down's syndrome, Alzheimer's disease); visual impairment that prevented reading; substance abuse; pregnancy.

After 476 people who met the study criteria had been identified, a request was sent by post 1–3 weeks in advance of their next clinical consultation inviting them to take part in the study. They were then recruited and, if willing to participate, consented when they were at the clinic. An additional letter was sent to those who did not come for their scheduled appointment at the clinic. If there was still no response, they were classified as non-responders ($n = 149$).

Participants were asked to provide information regarding age, sex, marital/co-habitation status (living alone vs. living with others), education (levels of education were dichotomized into university education: yes or no), employment status (working full-time, i.e. full-time employed and/or student, vs. working part-time, i.e. part-time employed and/or provisional disability benefit, vs. not working, i.e. paid leave of absence and/or unemployed or permanent disability benefit), height and weight. They were also asked to report condition-related information: diabetes duration; insulin regimen (insulin pump: yes or no); hypoglycaemic episodes (severe hypoglycaemia in the last 12 months: yes or no); and complications (any long-term complications, e.g. cardiovascular disease, nephropathy, retinopathy, neuropathy: yes or no).

A preliminary analysis identified a curvilinear relationship between frequency of self-monitoring of blood glucose and diabetes distress, in which distress was higher for those who performed self-monitoring of blood glucose either very infrequently (no monitoring in last 14 days, less than every week) or very frequently (4–6 times per day, ≥ 7 times per day), and lower for those who monitored their blood glucose with intermediate frequency (less than every day, 1–3 times per day). Self-monitoring of blood glucose frequency was therefore dichotomized into 'low distress' self-monitoring of blood glucose (less than every day and 1–3 times per day), and 'high distress' self-monitoring of blood glucose (all remaining groups).

In addition to completing a self-report questionnaire, all participants had HbA_{1c} assessed in connection with a regularly scheduled visit at the clinic. Samples were analysed at the University Hospital using high-performance liquid chromatography assays (DCA Vantage, DCA 2000 and DCA 2000 + ; Siemens/Bayer, Camberley, UK), standardized and calibrated against the International Federation of Clinical Chemists standards [12].

The questionnaire comprised three scales assessing psychosocial functioning, which are described below.

The Problem Areas In Diabetes (PAID) scale measures negative emotions related to living with diabetes (e.g. 'feeling alone with diabetes', 'feeling anger when…'), which were rated on a five-point scale (0–4 ranging from 'not a problem' to 'a very serious problem'). Scores are transformed to a 0–100 scale; higher scores represent greater distress. Elevated diabetes distress is identified as a score of ≥ 40 [13]. The PAID scale has been shown to have high internal consistency in the Norwegian population (Cronbach's α=0.93–0.95) [14]. In the present study, the Cronbach α coefficient was 0.94.

The Perceived Competence for Diabetes Scale (PCDS) assesses the degree to which people with diabetes feel they can manage the every-day aspects of diabetes care [15]. The PCDS contains four statements (e.g. 'I am able to manage my diabetes'), rated on a seven-point Likert scale indicating level of agreement (1–7, ranging from 'not at all true' to 'very true'); higher scores represent better respondent's performance. The mean of a person's responses is used as a summary score. The PCDS has internal consistencies of Cronbach's α ranging between 0.83 and 0.93 [11,15]. In the present study, the Cronbach's α coefficient was 0.92. The PCDS was translated into Norwegian and back-translated into English by professional translators, in accordance with the WHO guidelines [16].

The Health Care Climate Questionnaire (HCCQ) assesses patients' perceptions of the degree to which their healthcare providers are supportive of autonomy rather than controlling in consultations. This study used the short form containing six statements (e.g. 'I feel that my healthcare providers provide me with choices and options') rated on a seven-point Likert scale indicating level of agreement (1–7 ranging from 'strongly disagree' to 'strongly agree'). Higher scores represent greater perceived support for autonomy by healthcare professionals. The six-item short form has a Cronbach α coefficient of 0.82 [11]. In the present study, the Cronbach α coefficient was 0.95. The HCCQ was translated into Norwegian and back-translated into English by professional translators, in accordance with the WHO guidelines [16].

The Regional Committee for Medical and Health Research Ethics approved the study (2010/1325), and gave access to age, gender and the HbA_{1c} values of the non-responders. Participants gave full informed written consent to participate in the study.

Statistical analysis

To assess the association between PAID score and the set of predictors, we fitted an unadjusted linear regression model for each predictor and a blockwise linear regression model. The blocks of variables were entered according to their hypothesized causal ordering [17]: (a) socio-demographic (age, sex, level of education, co-habitation status and employment status) and clinical factors (long-term complications, insulin treatment regimen, self-monitoring of blood glucose, diabetes duration, episodes of severe hypoglycaemia, HbA_{1c} value and BMI); (b) self-perceived level of autonomy support (HCCQ score); and (c) self-perceived level of competence (PCDS score), respectively. To analyse the difference between non-participants and participants we used chi-squared and Mann–Whitney U-tests.

Missing values were handled by pairwise exclusion. The general significance level was set to 0.05. In the regression analyses, we took multiple testing effects into account. Because of the dependence of the tests in a regression, the Bonferroni adjustment would be too conservative, so we used an adjusted significance level of 0.01. R-squared change was used to assess the explanatory power of each block of variables as the incremental contribution to explained variance. The pathway from autonomy support to competence was estimated using a linear regression model with competence as outcome and the remaining predictors of the full model as predictors.

Results

Among all adults assessed for eligibility, 15.2% were found to be ineligible. Among those eligible ($n = 476$) the response rate was 37.4%, with non-participants equally distributed between non-responders and those who actively declined participation ($n = 149$ and $n = 149$, respectively; Fig. 1). Descriptive statistics are reported in Table 1. The mean age of the study sample ($n = 178$) was 36.7 ± 10.7 years and the median (range) disease duration was 19 (1–46) years. The mean HbA$_{1c}$ level was 78 ± 12 mmol/mol ($9.3 \pm 1.1\%$). In all, 31.5% of the participants had diabetes-related complications, and 42.7% had experienced severe hypoglycaemia within the previous 12 months. The study sample comprised 62.4% women, 96.6% were white, 35.9% had a university education and 13.5% were unemployed. In addition, 43.2% scored ≥ 40 on the PAID scale (data not shown).

Non-participants ($n = 298$) did not differ significantly from participants ($n = 178$) with regard to mean age (34.4 ± 11.2 vs. 36.7 ± 10.7 years; $P = 0.032$) or HbA$_{1c}$ [76 ± 13 mmol/mol ($9.2 \pm 1.2\%$) vs. 78 ± 11 mmol/mol ($9.3 \pm 1.1\%$); $P = 0.025$]; however, a significant sex ratio difference was found (male/female: 178 /120 vs. 67/111; $P < 0.001$).

Table 1 Characteristics of the study sample ($N = 178$)

Demographic characteristics	
Sex, women, n (%)	111 (62.4)
Mean (SD) age, years	36.7 (10.7)
Living alone, n (%)	28 (15.7)
University education, n (%)	
No University education	114 (64.1)
University education ≤ 4 years	44 (24.7)
University education > 4 years	20 (11.2)
Employment status, n (%)	
Working full-time	120 (67.4)
Working part-time	34 (19.1)
Not working	24 (13.5)
Clinical characteristics	
Median (range) diabetes duration, years*	19.0 (1–46)
Mean (SD) HbA1$_c$, mmol/mol	78 (12)
Mean (SD) HbA$_{1c}$, % points	9.3 (1.1)
Mean (SD) BMI, kg/m†	25.6 (4.0)
Long-term complications, n (%)	56 (31.5)
Insulin pump, n (%)	75 (42.1)
Severe hypoglycemia past year‡, n (%)	76 (42.7)
Frequency of self-monitoring blood glucose, n (%)	
≥ 7 times per day	21 (11.8)
4–6 times per day	54 (30.3)
1–3 times per day	54 (30.3)
Less than every day	28 (15.7)
Less than every week	12 (6.7)
No monitoring last 14 days	9 (5.1)
Psychosocial functioning (defined range)	
Mean (SD) PAID scale score (0–100)	37.2 (20.5)
Mean (SD) PCDS score (1–7)	4.3 (1.5)
Mean (SD) HCCQ score (1–7)	5.0 (1.5)

PAID, Problem Areas in Diabetes; PCDS, Perceived Competence in Diabetes Scale; HCCQ, Health Care Climate Questionnaire.
*$n = 174$.
$^\dagger n = 171$.
$^\ddagger n = 176$.

The results of blockwise regression analyses are shown in Table 2. Self-perceived autonomy support (HCCQ) and diabetes self-perceived competence (PCDS) contributed a statistically significant amount to the model's explained variance, 6.3 and 32.9%, respectively. Both variables of interest were significant upon entry into the model. A significant negative association was found between self-perceived autonomy support and diabetes distress (B = -3.61; $P = 0.001$), indicating that lower self-perceived autonomy support was associated with greater distress. When self-perceived competence was controlled, it mediated the association of self-perceived autonomy support with diabetes distress, reducing it to non-significance (B = -0.03, $P = 0.969$). There was a significant negative association between self-perceived competence and diabetes distress (B = -8.89, $P < 0.001$), indicating that lower self-perceived competence was associated with greater distress. These results identify an indirect (fully mediated) relationship between self-perceived autonomy support and diabetes distress; autonomy support is associated with higher self-perceived competence, which in turn is associated with lower distress. The estimate of the pathway from autonomy support to self-perceived competence was B = 0.40 ($P < 0.001$; not shown in Table 2). We noted that diabetes distress was higher in those who monitored blood glucose either infrequently or very frequently.

Discussion

In the present study a significant negative association between the perceived level of autonomy support from healthcare providers and diabetes distress was identified. Interestingly, among people with a suboptimally controlled Type 1 diabetes these associations seemed to be mediated through the level of self-perceived competence in managing diabetes. In diabetes care, competence is especially challenging and important because adequate self-management is pivotal to securing optimum treatment of the condition. It is well known that health outcomes are influenced by the individual's level of perceived competence and this has been the subject of many educational, motivational and psychosocial intervention studies [18]. Although a variety of programmes show positive results, most lack evidence that they are effective in different populations [19]. Additional research to investigate the relationship between autonomy support and clinical outcomes has been suggested [20]. The results of the present study may contribute to the discussion regarding how to create more successful and theory-based motivational interventions.

Low competence has been associated with poor knowledge and understanding of HbA$_{1c}$ among people with diabetes [22]. While the causal dynamics underlying this association are unknown, it has been hypothesized that low self-perceived competence might be a consequence of poor ability to manage the daily stressors caused by diabetes self-management [23]. In turn, perceiving one's own compe-

Table 2 Blockwise linear regression analysis for related variables associated with Problem Areas in Diabetes (PAID) among persons with Type 1 diabetes 18–55 years (N = 178).

	Unadjusted analysis*†			Step A Demographic and clinical			Step B Autonomy Support			Step C Competence		
	B	95% CI	P	B	95% CI	P	B	95% CI	P	B	95% CI	P
Sex	4.39	-1.87 10.65	0.168	3.60	-3.10 10.31	0.290	3.70	-2.78 10.18	0.261	2.78	-2.20 7.76	0.271
Age	-0.36	-0.64 -0.07	0.014	-0.25	-0.62 0.13	0.196	-0.27	-0.63 0.09	0.139	-0.10	-0.38 0.18	0.480
Education University	-5.53	-11.83 0.77	0.085	-1.35	-8.18 5.47	0.696	-3.55	-10.27 3.16	0.297	-2.77	-7.93 2.39	0.290
Living alone	2.66	-5.70 11.03	0.531	2.83	-6.14 11.79	0.534	2.53	-6.13 11.19	0.565	4.35	-2.31 11.01	0.199
Employed	-2.65	-6.87 1.57	0.217	-2.74	-7.26 1.78	0.233	-2.80	-7.17 1.57	0.207	-1.89	-5.24 1.47	0.269
Long-term complications	1.27	-5.29 7.84	0.702	3.35	-3.68 10.39	0.348	3.64	-3.15 10.44	0.291	3.81	-1.41 9.03	0.151
Pump	-1.43	-7.60 4.75	0.649	-2.66	-9.34 4.03	0.434	-3.74	-10.22 2.75	0.257	-3.74	-8.72 1.24	0.140
Self-monitoring of blood glucose	7.76	1.76 13.77	0.012	7.77	1.36 14.18	0.018	8.68	2.47 14.89	0.006	5.58	0.77 10.38	0.023
Diabetes duration	-0.41	-0.68 -0.13	0.004	-0.29	-0.66 0.09	0.135	-0.22	-0.58 0.15	0.238	-0.16	-0.44 0.12	0.248
Severe hypoglycaemia	1.82	-4.36 8.01	0.562	2.17	-4.25 8.59	0.504	0.69	-5.56 6.95	0.827	-2.20	-7.04 2.64	0.370
HbA$_{1c}$ (%)	3.12	0.37 5.88	0.026	2.67	-0.31 5.65	0.079	2.25	-0.64 5.14	0.126	-0.31	-2.58 1.97	0.790
BMI	-0.28	-1.07 0.50	0.478	0.40	-0.45 1.24	0.355	0.42	-0.40 1.23	0.313	0.27	-0.36 0.89	0.395
HCCQ mean	-3.29	-5.31 -1.26	0.002				-3.61	-5.67 -1.56	0.001	-0.03	-1.76 1.69	0.969
PCDS mean	-9.09	-10.54 -7.64	<0.001							-8.89	-10.59 -7.20	<0.001
Overall R square				0.143			0.206			0.535		
Change in R square							0.063			0.329		

PCDS, Perceived Competence in Diabetes Scale; HCCQ, Health Care Climate Questionnaire.
*Unstandardized regression coefficients.
†Each cell in this column represents the coefficients from a bivariate regression analysis.

Diabetic Medicine Published by John Wiley & Sons Ltd on behalf of Diabetes UK.

1517

tence to be low can in itself be distressing. The findings of the present study suggest a need for a revised approach with regard to how healthcare providers deal with competence among adults with suboptimally regulated Type 1 diabetes. It has been shown that as people become more autonomously motivated, they regard themselves as more competent in attaining the desired outcomes [24]. Some studies also suggest that the support of healthcare providers may be a powerful factor influencing individuals' management of their condition [25]. Other studies suggest that a non-supportive relationship with healthcare providers can become a stressor and a hindrance to effective disease management [26].

In efforts to individualize diabetes care, as recommended by the American Association of Diabetes Educators [27], diabetes care providers need to assess life challenges, as well as personal resources. In spite of having suboptimum control of Type 1 diabetes and a rather substantial level of diabetes distress (43% scoring ≥ 40 on the PAID scale), the respondents had many life resources, including being young, well-educated and employed. In their recent review article, Barnard *et al.* [28] introduced a model of diabetes care that incorporates the various influences on diabetes self-management, including feelings, beliefs and personal motivation. The findings of the present study encourage further discussion of this model of diabetes care, specifically the inclusion of each person's perceived level of autonomy support and self-perceived competence in efforts to assess and alleviate diabetes distress.

This study has limitations. First, the cross-sectional design limits the potential for drawing conclusions about causality or about directions of the relationships between diabetes distress and the explanatory variables; however, we were able to indicate whether the data were (or were not) consistent with the hypotheses regarding causal relationships. Second, only one third of the potentially eligible sample participated in the study and we were not able to assess socio-economic differences between participants and non-participants, which may restrict the study's generalizability. Not unlike tendencies among people with chronic conditions in general [29], the frequency of non-participation was considerable in the present study population, which is a possible threat to the study's validity. In addition, two out of three participants were female, and women generally report higher levels of diabetes-related distress than men [30]. In spite of inclusion criteria [HbA$_{1c}$ $\geq$ 64 mmol/mol ($\geq$8.0%)], a substantial number (40%) of participants had experienced hypoglycaemia in the past 12 months. This finding might call into question the representativeness of the sample. Another limitation is the lack of measures of participants' behaviours that might mediate or moderate the associations between competence and glycaemic control. It would have strengthened the study if we had had more data on the non-participants. Nevertheless, we did have some core data on all the eligible patients: age, gender and HbA$_{1c}$ values.

The results of the present study are consistent with the hypothesis that the level of autonomy support received by a person with diabetes from healthcare professionals might influence the level of self-perceived competence and thus indirectly promote improved diabetes self-management and glycaemic control. This finding is consistent with other researchers who have confirmed that motivation based on free choice instead of external control (as defined by Self-Determination Theory) is associated with improved HbA$_{1c}$ values and that perceiving oneself to be competent in managing diabetes is associated with improved glycaemic control [21]. Although, in the present study, autonomy support only accounts for 6.3% of explained variance in diabetes distress, all clinical and demographic measures combined to account for only twice that variance in distress. A difference of one standard deviation in the perceived autonomy support score reflects a difference of 5.4 points in the diabetes distress score; thus, our results suggest that if healthcare professionals were to provide autonomy support this might contribute to improved diabetes outcomes, as self-perceived competence may facilitate optimum diabetes self-management and contribute to a decreased level of diabetes distress.

This finding contributes to a broader understanding of diabetes distress and adds to the discussion of the complexity of factors affecting suboptimum glycaemic control and to the importance of healthcare providers' consultation style.

In conclusion, self-perceived autonomy support from healthcare providers is associated with increased self-perceived competence and, in turn, with diabetes distress. Enhancing self-perceived competence through treatment strategies supportive of autonomy may contribute to more effective and efficient self-management for people with suboptimum glycaemic control. Because diabetes distress is also a matter of concern for people with optimum glycaemic control, further research should address these hypotheses in that sub-population.

Competing interests

None declared.

References

1 Egede LE, Dismuke CE. Serious psychological distress and diabetes: a review of the literature. *Curr Psychiatr Rep* 2012; **14**: 15–22.

2 van Bastelaar KM, Pouwer F, Geelhoed-Duijvestijn PH, Tack CJ, Bazelmans E, Beekman AT *et al*. Diabetes-specific emotional distress mediates the association between depressive symptoms and glycaemic control in Type 1 and Type 2 diabetes. *Diabet Med* 2010; **27**: 798–803.

3 Schram MT, Baan CA, Pouwer F. Depression and quality of life in patients with diabetes: a systematic review from the European depression in diabetes (EDID) research consortium. *Curr Diabetes Rev* 2009; **5**: 112–119.

4 Peyrot M, Rubin RR, Lauritzen T, Snoek FJ, Matthews DR, Skovlund SE. Psychosocial problems and barriers to improved diabetes management: results of the Cross-National Diabetes Attitudes, Wishes and Needs (DAWN) Study. *Diabet Med* 2005; **22**: 1379–1385.

5 Fisher L, Mullan JT, Arean P, Glasgow RE, Hessler D, Masharani U. Diabetes distress but not clinical depression or depressive symptoms is associated with glycemic control in both cross-sectional and longitudinal analyses. *Diabetes Care* 2010; **33**: 23–28.

6 Wasserman LI, Trifonova EA. Diabetes mellitus as a model of psychosomatic and somatopsychic interrelationships. *Span J Psychol* 2006; **9**: 75–85.

7 Nicolucci A, Kovacs Burns K, Holt RI, Comaschi M, Hermanns N, Ishii H *et al*. Diabetes Attitudes, Wishes and Needs second study (DAWN2): cross-national benchmarking of diabetes-related psychosocial outcomes for people with diabetes. *Diabet Med* 2013; **30**: 767–777.

8 Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol* 2000; **55**: 68–78.

9 Williams GC, Patrick H, Niemiec CP, Williams LK, Divine G, Lafata JE *et al*. Reducing the health risks of diabetes: how self-determination theory may help improve medication adherence and quality of life. *Diabetes Educator* 2009; **35**: 484–492.

10 Deci EL, Ryan RM. *Handbook of self-determination research*. Rochester, NY: University of Rochester Press, 2002.

11 Williams GC, McGregor HA, Zeldman A, Freedman ZR, Deci EL. Testing a self-determination theory process model for promoting glycemic control through diabetes self-management. *Health Psychol* 2004; **23**: 58–66.

12 Hoelzel W, Weykamp C, Jeppsson JO, Miedema K, Barr JR, Goodall I *et al*. IFCC reference system for measurement of hemoglobin A1c in human blood and the national standardization schemes in the United States, Japan, and Sweden: a method-comparison study. *Clin Chem* 2004; **50**: 166–174.

13 Hermanns N, Kulzer B, Krichbaum M, Kubiak T, Haak T. How to screen for depression and emotional problems in patients with diabetes: comparison of screening characteristics of depression questionnaires, measurement of diabetes-specific emotional problems and standard clinical assessment. *Diabetologia* 2006; **49**: 469–477.

14 Graue M, Haugstvedt A, Wentzel-Larsen T, Iversen MM, Karlsen B, Rokne B. Diabetes-related emotional distress in adults: reliability and validity of the Norwegian versions of the Problem Areas in Diabetes Scale (PAID) and the Diabetes Distress Scale (DDS). *Int J Nurs Stud* 2012; **49**: 174–182.

15 Williams GC, McGregor HA, King D, Nelson CC, Glasgow RE. Variation in perceived competence, glycemic control, and patient satisfaction: relationship to autonomy support from physicians. *Patient Educ Couns* 2005; **57**: 39–45.

16 World Health Organization. Process of translation and adaption of instruments. Available at http://www.who.int/substance_abuse/research_tools/translation/en/ Last accessed 14 May 2014.

17 Peyrot M. Causal analysis: theory and application. *J Pediatric Psychol* 1996; **21**: 3–24.

18 Clark M. Diabetes self-management education: a review of published studies. *Prim Care Diabetes* 2008; **2**: 113–120.

19 Thorpe CT, Fahey LE, Johnson H, Deshpande M, Thorpe JM, Fisher EB. Facilitating healthy coping in patients with diabetes: a systematic review. *Diabetes Educ* 2013; **39**: 33–52.

20 Lee YY, Lin JL. Do patient autonomy preferences matter? Linking patient-centered care to patient-physician relationships and health outcomes. *Soc Sci Med* 2010; **71**: 1811–1818.

21 Zoffmann V, Vistisen D, Due-Christensen M. A cross-sectional study of glycaemic control, complications and psychosocial functioning among 18- to 35-year-old adults with Type 1 diabetes. *Diabet Med* 2014; **31**: 493–499.

22 Beard E, Clark M, Hurel S, Cooke D. Do people with diabetes understand their clinical marker of long-term glycemic control (HbA1c levels) and does this predict diabetes self-care behaviours and HbA1c? *Patient Educ Couns* 2010; **80**: 227–232.

23 Duangdao KM, Roesch SC. Coping with diabetes in adulthood: a meta-analysis. *J Behav Med* 2008; **31**: 291–300.

24 Julien E, Senecal C, Guay F. Longitudinal relations among perceived autonomy support from health care practitioners, motivation, coping strategies and dietary compliance in a sample of adults with type 2 diabetes. *J Health Psychol* 2009; **14**: 457–470.

25 Thorne SE, Paterson BL. Health care professional support for self-care management in chronic illness: insights from diabetes research. *Patient Educ Couns* 2001; **42**: 81–90.

26 Karlsen B, Oftedal B, Bru E. The relationship between clinical indicators, coping styles, perceived support and diabetes-related distress among adults with type 2 diabetes. *J Adv Nurs* 2012; **68**: 391–401.

27 American Association of Diabetes Educators. Individualization of diabetes self-management education. *Diabetes Educator* 2002; **28** (741–745): 749.

28 Barnard KD, Lloyd CE, Dyson PA, Davies MJ, O'Neil S, Kamunilli N *et al*. Kaleidoscope model of diabetes care: time for a rethink? *Diabet Med* 2014; **31**: 522–530.

29 Hasvold PE, Wootton R. Use of telephone and SMS reminders to improve attendance at hospital appointments: a systematic review. *J Telemed Telecare* 2011; **17**: 358–364.

30 Fisher L, Skaff MM, Mullan JT, Arean P, Glasgow R, Masharani U. A longitudinal study of affective and anxiety disorders, depressive affect and diabetes distress in adults with Type 2 diabetes. *Diabet Med* 2008; **25**: 1096–1101.